

## 6. MITIGATION AND MONITORING

### 6.1 Introduction

In the USACE Regulatory Program, the term “mitigation” has two separate and distinct contexts as defined by two separate and distinct laws and regulations. The CEQ regulations implementing NEPA refer to “mitigation,” while the USACE regulations pursuant to the CWA refer to “compensatory mitigation.” Although confusing at times, the terms “mitigation” and “compensatory mitigation” in the context of NEPA and the CWA are not interchangeable. When applying these terms to a DA permit application, they have different requirements, as shown below.

<p><b><i>NEPA “Mitigation” as defined in 40 CFR 1508.20:</i></b></p> <ul style="list-style-type: none"> <li>(a) Avoiding the impact altogether by not taking a certain action or parts of an action.</li> <li>(b) Minimizing impacts by limiting the degree or magnitude of the action and its implementation.</li> <li>(c) Rectifying the impact by repairing, rehabilitating, or restoring the affected environment.</li> <li>(d) Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action.</li> <li>(e) Compensating for the impact by replacing or providing substitute resources or environments.</li> </ul>	<p><b><i>CWA “Compensatory Mitigation” as defined in the USACE and USEPA regulations:</i></b></p> <p>...The restoration (re-establishment or rehabilitation), establishment (creation), enhancement, and/or in certain circumstances preservation of aquatic resources for the purposes of offsetting unavoidable adverse impacts which remain after all appropriate and practicable avoidance and minimization has been achieved.</p>
--	--

The objective of the CWA is “to restore and maintain the chemical, physical, and biological integrity of the nation’s waters.” To achieve this goal, the CWA prohibits the discharge of dredged or fill material into wetlands, streams, and other Waters of the U.S. unless the USACE issues a DA permit. When a discharge is proposed, all appropriate and practicable steps must first be taken to avoid and minimize impacts on aquatic resources. For unavoidable impacts, compensatory mitigation is required to replace the loss of wetland, stream, and other aquatic resource functions.

NEPA and its implementing regulations require that an EIS identify appropriate mitigation measures for the adverse impacts potentially resulting from a proposed action. Under NEPA, mitigation measures are actions that could be taken to avoid, minimize, rectify, reduce, eliminate, or compensate for adverse effects to the environment (40 CFR 1508.20).

This Draft EIS considers numerous measures to reduce impacts on environmental resources from the proposed Project. Although some of these measures are not strictly *mitigation* measures under the CWA or NEPA, they are identified in this chapter to provide a complete summary of all measures that have been considered in the design and development of the proposed Project, as well as those that are being

considered as additional measures for public review. These measures are identified as avoidance, minimization, and compensatory mitigation under the CWA and as avoidance and minimization measures under NEPA, although many would apply to both regulations. This chapter discusses the compensatory mitigation requirements of the CWA and the mitigation requirements of NEPA under the following topics:

- Avoidance, minimization, and compensatory mitigation under the CWA
  - Avoidance achieved during the DA application review process;
  - Minimization of impacts; and
  - Compensatory mitigation pursuant to *Compensatory Mitigation for Losses of Aquatic Resources, Final Rule* (USACE and USEPA 2008) (referred to herein as the *Mitigation Rule*) and the Compensatory Mitigation Plan proposed by Haile (Appendix B).
- Avoidance and minimization measures under NEPA
  - Avoidance and minimization measures proposed by the Applicant as part of the Project design or as standard procedures during operations;
  - Additional mitigation measures being considered by the USACE to further avoid or minimize impacts;
  - The Applicant's proposed MMP (Haile 2013a) (Appendix G); and
  - Monitoring and adaptive management measures being considered by the USACE to ensure that mitigation is being performed and is achieving the expected results or monitoring for adaptive management.

These measures are described in the sections that follow.

## **6.2 Avoidance, Minimization, and Compensatory Mitigation under the Clean Water Act**

### **6.2.1 Avoidance Achieved during the DA Application Review Process**

The most substantial reduction in potential impacts was achieved when the Applicant, in close coordination with analysis by the USACE, reconfigured and revised the proposed Project as described in Chapter 2. The revised mine plan (Haile 2012) resulted in an approximately 25-percent reduction in overall acreage of direct impacts on wetlands and an approximately 32-percent reduction in direct impacts on streams compared to the site layout and mine plan filed in the Applicant's initial DA permit application (Haile 2011).

### **6.2.2 Minimization of Impacts**

Chapter 2 describes the process by which alternatives to the proposed Project were considered, with the objective of reducing impacts on Waters of the U.S. and other environmental resources. This process considered alternative mining and ore processing methods, alternative sites for facilities, and alternate Project configurations, among other alternatives. Most alternatives were eliminated from further consideration because they were not practicable or would not further reduce impacts on Waters of the U.S. from those of the proposed Project. The alternatives analysis identified one alternative to the proposed Project. As described in Chapter 2, the Modified Project Alternative would further reduce direct impacts on Waters of the U.S.

Other alternative Project configurations were eliminated from further consideration because the extensive groundwater lowering around the mine pits would result in considerable indirect impacts on Waters of the U.S. irrespective of the location of the mine pits (see Section 4.6, “Wetlands and Other Waters of the United States” for additional discussion). The long-term indirect impacts on Waters of the U.S. would occur nearest the mine pits, and the most substantial impacts within an approximately 0.5-mile radius, making further avoidance of direct impacts on Waters of the U.S. much less meaningful or moot.

### **6.2.3 Compensatory Mitigation**

Compensatory mitigation is a critical tool to help the USACE and the USEPA ensure that a project’s impacts are offset by compensation to meet the long-standing national goal of “no net loss” of wetland functions and values, identified in EO 11990, *Protection of Wetlands*. For projects authorized under Section 404 of the CWA, compensatory mitigation is not considered until after all appropriate and practicable steps have been taken to first avoid and then minimize adverse impacts on the aquatic ecosystem (40 CFR 230). Compensatory mitigation is used for resource losses that are specifically identifiable, reasonably likely to occur, and of importance to the human or aquatic environment. Compensatory mitigation can be carried out through restoration of an existing wetland or other aquatic site, enhancement of the functions of an existing aquatic site, creation of a new aquatic site, or preservation of an existing aquatic site.

In the event that the DA permit application for the proposed Project is issued, the USACE would determine whether the specific compensatory mitigation plan is “environmentally preferable” for the Haile Gold Mine Project. As part of this process, the USACE would implement the requirements in the Mitigation Rule. The Mitigation Rule identifies the steps necessary to determine the level of compensatory mitigation that is appropriate based on the wetland functions lost or adversely affected by permitted activities.

#### **6.2.3.1 Compensatory Mitigation for Impacts on Waters of the United States**

The Mitigation Rule outlines the process for selection of compensatory mitigation. The Mitigation Rule includes a preference hierarchy for the three types of compensatory mitigation: (1) mitigation banks; (2) in-lieu fee programs; and (3) permittee-responsible mitigation plans. Mitigation banks are given preference because

*[They] typically involve larger, more ecologically valuable parcels, and more rigorous scientific and technical analysis.... [They] require site identification in advance, project-specific planning, and significant investment of financial resources.*

The Mitigation Rule allows that the preference hierarchy can be overridden in cases when, using the review criteria listed above, “a permittee-responsible project will restore an outstanding resource based on rigorous scientific and technical analysis” (33 CFR 332.3[b][2]). In cases such as the Haile Gold Mine, where impacts occur outside of the service area of approved mitigation banks and in-lieu fee programs, the Mitigation Rule specifies that permittee-responsible mitigation, preferably under a watershed approach, must be provided (33 CFR 332.3[b][4]).

The Mitigation Rule grants the District Engineer authority and discretion to determine the appropriate compensatory mitigation for impacts authorized under a DA permit. Text in 33 CFR 332.3(b) specifically states:

*“In general, the required compensatory mitigation should be located within the same watershed as the impact site, and should be located where it is most likely to successfully replace lost functions and*

*services, taking into account such watershed scale features as aquatic habitat diversity, habitat connectivity, relationships to hydrologic sources (including the availability of water rights), trends in land use, ecological benefits, and compatibility with adjacent land uses.” (emphasis added)*

### 6.2.3.2 Haile’s Proposed Compensatory Mitigation Plan

Haile has proposed a permittee-responsible Compensatory Mitigation Plan (Appendix B) to offset Project-related effects on Waters of the U.S. The SCDNR was consulted and contributed to the identification of mitigation opportunities for Haile to consider in the formulation of its plan. This included an exhaustive search in the Lynches River watershed for high-quality mitigation areas. As a result of this search, Haile’s proposed Compensatory Mitigation Plan includes an ecologically significant site within the Lynches River watershed (HUC 03040202) called Rainbow Ranch.

Overall, Haile’s proposed plan involves perpetual preservation of three sites totaling 4,388.8 acres and endowments for site maintenance, management, and restoration, and projects to benefit the Carolina heelsplitter mussel. The plan proposes to convey ownership of the three properties, located within the same ecoregion as the proposed Project, to the SCDNR as a Heritage Preserve under SCDNR’s Heritage Trust Program. The Heritage Trust Program was created to “set aside a portion of the state’s rich natural and cultural heritage in a system of heritage preserves to be protected for the benefit of present and future generations.” In a letter to the USACE dated September 16, 2013, the SCDNR characterized the sites proposed by Haile as “significant natural areas.” On this basis, the SCDNR determined that these sites could be accepted into its Heritage Trust Program, which would afford them “the highest order of long-term protection that can be provided by state government.”

In addition to the purchase price of the actual properties, Haile would provide \$9.4 million to the Heritage Trust Program in endowments. That amount would be divided into \$4.5 million for maintenance, management, and restoration of the mitigation sites and \$4.9 million for projects benefiting the Carolina heelsplitter mussel. The proposed endowment would allow the Heritage Trust Program to manage the properties in a holistic, ecological manner and would provide ample opportunities over the long term to restore and enhance wetlands and streams on all three tracts.

The mitigation sites proposed by Haile include Rainbow Ranch, Cooks Mountain, and Goodwill Plantation. Table 6-1 summarizes the aquatic features and acreages of the proposed mitigation sites.

**Table 6-1 Aquatic Features and Acreages of Applicant’s Proposed Mitigation Sites**

Site	Total Site Acreage	Streams (linear feet)	Wateree River Shoreline <sup>a</sup> (linear feet)	Wetlands (acres)
Rainbow Ranch	698.0	19,714	-	28.1
Cooks Mountain	1,131.8	28,292	10,289	485.1
Goodwill Plantation	2,559.0	30,706	29,560	1,048.1
<b>Total</b>	<b>4,388.8</b>	<b>78,712</b>	<b>39,849</b>	<b>1,561.3</b>

<sup>a</sup> West bank of the Wateree River shoreline only.

- **Rainbow Ranch** – Rainbow Ranch is a 698-acre site located in the Lynches River watershed (HUC 03040202) and EPA Level III Piedmont and Southeastern Plains ecoregions in Lancaster County. The site is adjacent to 2,267 acres of state preserve lands. The approximately 28 acres of palustrine wetlands in the site include scrub-shrub, forested, and emergent communities. The property includes federally designated critical habitat for the Carolina heelsplitter mussel. The Sandhills chub, a state-listed species of concern, is anticipated to also benefit from the downstream water quality improvements to the Lynches River provided by preservation of this property. Rainbow Ranch is adjacent to the Forty Acre Rock Heritage Preserve, a South Carolina Heritage Trust Preserve, and the privately owned Carolina Heelsplitter Conservation Bank. Rainbow Ranch's inclusion into the Forty Acre Rock Heritage Preserve will increase the size of the Preserve by over 30%.
- **Cooks Mountain** – Cooks Mountain is comprised of two parcels totaling approximately 1,132 acres located in the Wateree River watershed in Richland County; the site is adjacent to the Goodwill Plantation site. Within this acreage, there are 485 acres of primarily palustrine forested and scrub-shrub wetlands, 28,292 linear feet of stream, and 10,289 linear feet of shoreline comprising the west bank of the Wateree River. These are described by Haile as “functional and in an undisturbed state relative to passive recreation use.” The Cooks Mountain site includes high levels of plant diversity unique to relatively undisturbed areas and topographic relief not commonly found in this region of South Carolina (e.g., elevations approaching 400 feet above sea level adjacent to the Wateree River). In addition to compensatory wetland mitigation, the Cooks Mountain site offers the potential for other public benefits such as low-impact recreation (e.g., hunting and hiking), environmental education events at the existing education center, and cultural resource and biodiversity research opportunities.
- **Goodwill Plantation** – The Goodwill Plantation site is 2,559 acres located in the Wateree River watershed in Richland County. Its northern boundary abuts the Cooks Mountain property. Within this acreage, there are 1,048 acres of primarily palustrine forested and scrub-shrub wetlands, 30,706 linear feet of stream, and 29,560 linear feet of shoreline comprising the west bank of the Wateree River. These are described by Haile as “functional and in an undisturbed state relative to passive recreation use.” The site contains diverse plant communities and supports a reproductive population of the rare Carolina egg-in-a-nest mint (*Machbridea caroliniana*).

Together, the Goodwill Plantation and Cooks Mountain properties would provide an approximately 3,660-acre wildlife corridor within the Congaree, Wateree, and Santee (COWASEE) Basin Focus Area. Additional public benefits provided by preservation of the Goodwill Plantation include perpetual protection of numerous cultural resources known to occur on the site, including Goodwill Plantation itself, which has been listed in the NRHP since 1986.

## 6.3 Avoidance and Minimization Measures under NEPA

### 6.3.1 Avoidance and Minimization Measures

The Applicant's measures to avoid and minimize potential impacts of the proposed Project are summarized by resource area in Table 6-2, based on information provided in various reports and plans submitted by Haile. The USACE views these elements as part of the Applicant's Proposed Project and the Modified Project Alternative for purposes of the environmental impacts analysis presented in Chapter 4. Some of these measures are required under federal, state, and local permits; others are measures that Haile has incorporated into the design and operation of the proposed Project.

Measures from a number of categories in Table 6-2 may be applicable to more than one resource area. For example, certain measures listed under surface water resources may also help to avoid or minimize potential impacts on wetlands and Waters of the U.S.

**Table 6-2 Summary of Avoidance and Minimization Measures**

Resource Area	Avoidance and Minimization Measures
Geology and soils	<p>Implement Storm Water Pollution and Prevention Plans (SWPPPs) as required by Haile's National Pollutant Discharge Elimination System (NPDES) permit, including management of sediment and erosion control.</p> <p>Implement a Spill Prevention Control and Countermeasures (SPCC) Plan for petroleum products.</p> <p>Implement spill prevention and control measures for process and reagent tanks and pipelines.</p> <p>Use methods of managing sediment and erosion control during construction pursuant to the <i>South Carolina Stormwater Management Handbook</i> (South Carolina Department of Health and Environmental Control [SCDHEC] 2005).</p> <p>Design facility slopes to minimize erosion, as feasible.</p> <p>Store and re-use growth media for use during reclamation, minimizing disturbance of additional soils.</p> <p>Implement an overburden management plan, including segregating and placing rock based on the content of potentially-acid generating (PAG) materials.</p> <p>Perform concurrent and final reclamation to minimize soil loss and erosion.</p>
Groundwater hydrology and water quality	<p>Implement a groundwater monitoring and reporting program during operations and post-mining per the SCDHEC Mine Operating permit.</p> <p>Comply with requirements of the NPDES permit, including groundwater monitoring.</p> <p>Amend Yellow Class overburden material used as pit backfill with lime to minimize acid rock drainage during operations.</p> <p>Use composite liner (low-permeability soil liner and high-density polyethylene [HDPE] liner) at the tailings storage facility (TSF) and Johnny's PAG.</p> <p>Provide drainage for groundwater from under Johnny's PAG and the TSF.</p> <p>Install HDPE cover on the TSF and Johnny's PAG during closure to minimize impacts on water quality.</p> <p>Install a double HDPE liner at the TSF Underdrain Collection Pond, 465 Collection Pond, 469 Collection Pond, and 19 Pond; and install a single HDPE liner at the Process Event Pond.</p> <p>Implement a leak collection and recovery system (LCRS) at all double HDPE-lined ponds.</p> <p>Conduct post-mining reclamation and closure monitoring for purposes of ensuring continued compliance with permit requirements.</p> <p>Seal abandoned wells.</p>
Surface water hydrology and water quality	<p>Construct a Process Event Pond to contain a spill that exceeds a facility's containment capacity or a failure of the TSF slurry pipeline.</p> <p>Implement an overburden characterization and management plan, including; segregating and placing rock based on the content of PAG materials.</p> <p>Provide double-walled pipelines for the TSF slurry pipeline to prevent and contain a spill;</p> <p>Install pressure-sensing alarms for the tailings and reclaim water pipeline systems and certain contact water lines.</p> <p>Install automatic shut-off on the contact water pipeline system.</p> <p>Treat runoff and seepage from Johnny's PAG and other contact waters during operations in an NPDES-permitted water treatment plant prior to release.</p> <p>Treat drain-down from Johnny's PAG and the TSF during closure in an NPDES-permitted treatment system prior to release.</p> <p>Use a water-resistant ammonium nitrate emulsion blasting agent to minimize impacts on nearby waterbodies and groundwater.</p> <p>Expedite Ledbetter Pit Lake refilling to minimize impacts on water quality.</p>

**Table 6-2 Summary of Avoidance and Minimization Measures (Continued)**

Resource Area	Avoidance and Minimization Measures
Surface water hydrology and water quality (Continued)	<p>Actively treat pit lakes during refilling to minimize impacts on water quality.</p> <p>Perform concurrent and final reclamation to minimize impacts on water quality.</p> <p>Implement spill prevention and control measures for petroleum products, reagents, processes, and pipelines.</p> <p>Implement a surface water monitoring and reporting program during operations and post-mining.</p> <p>Comply with requirements of the NPDES permit, including discharges to surface waters.</p> <p>Implement a SWPPP as required by the industrial stormwater NPDES permit.</p> <p>Implement dust control measures for roads and construction areas.</p> <p>Design the TSF to contain the probable maximum precipitation event (approximately 48 inches) with 48 inches of freeboard.</p> <p>Comply with the requirements of Dam Safety permit.</p> <p>Comply with the requirements of Surface Water Withdrawal permit during refilling of Ledbetter Pit Lake, as applicable.</p> <p>Monitor the structural integrity of TSF embankment.</p> <p>Route stormwater around Johnny's PAG.</p> <p>Design culverts to maintain existing surface drainage patterns and prevent erosion.</p> <p>Route depressurization water through the dust control holding tanks, which will assist in acclimating water to ambient temperature and increasing dissolved oxygen levels prior to release to streams.</p> <p>Implement 50-foot vegetative buffers around otherwise not directly affected Waters of the U.S.</p>
Water supply and floodplains	<p>Construct mine facilities outside of the 100-year floodplain.</p> <p>Implement a program to investigate complaints from water users about potential impacts on wells, ponds, and springs due to mine operations, and provide remedial response as appropriate.</p> <p>Recycle/re-use process water to minimize water consumption.</p>
Wetlands and other waters of the United States; aquatic resources	<p>Design and locate mine facilities to reduce impacts on Waters of the U.S.</p> <p>Concentrate and confine impacts to previously disturbed areas, where feasible.</p> <p>Avoid mine roads crossing Waters of the U.S. Where crossing is necessary, minimize impacts by crossing at the narrowest portion or by siting over existing road crossings.</p> <p>Include Haile Gold Mine Creek detention and diversion structure within the footprint of the haul road crossing.</p> <p>Include North Fork of Haile Gold Mine Creek diversion structure within the footprint of the road crossing.</p> <p>Implement 50-foot vegetative buffers around otherwise not directly affected Waters of the U.S.</p>
Terrestrial resources	<p>Follow Migratory Bird Treaty Act terms described in 16 U.S. Code 703(a).</p> <p>Design substations and distribution and transmission lines to follow the guidelines in the Rural Utilities Service substation design and transmission line design handbooks (RUS 2001, 2009).</p> <p>Design and construct transmission lines to follow the guidelines in <i>Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006</i> (APLIC 2006).</p> <p>Implement an Avian Protection Plan at the mine site for transmission lines, including designing power lines and poles to minimize potential bird mortalities due to electrocution.</p>

**Table 6-2 Summary of Avoidance and Minimization Measures (Continued)**

Resource Area	Avoidance and Minimization Measures
Terrestrial resources (continued)	<p>Develop procedures for managing nests of protected species on utility structures (if nests are built).</p> <p>Install an 8-foot fence around all HDPE double-lined ponds and the TSF facility to exclude wildlife from the TSF pond.</p> <p>Regularly inspect and maintain all fencing around HDPE double-lined ponds and the TSF perimeter.</p> <p>Use skirting to enclose open spaces as necessary beneath raised structures.</p> <p>Limit the concentration of weak acid dissociable cyanide in the TSF Reclaim Pond to a maximum of 50 parts per million.</p> <p>Avoid features possibly attractive to wildlife in HDPE double-lined ponds, as possible.</p> <p>Maintain slopes around water ponds to restrict access, where necessary, and to provide a means of escape for trapped animals.</p> <p>Clear vegetation surrounding the perimeter of HDPE-lined ponds, and minimize infrastructure around open-solution ponds and the TSF where practicable.</p> <p>Use certified as noxious-weed-free seed mixes to promote diverse wildlife in areas undergoing final reclamation.</p> <p>During final grading of facilities during reclamation, leave occasional large boulders that are uncovered during sloping on the surface to provide microhabitats for wildlife and vegetation.</p> <p>Ensure that workers do not intentionally feed, harass, or approach wildlife.</p> <p>Follow posted speed limits for traffic in the Project area to reduce incidents with wildlife.</p>
Land use	Return disturbed areas to a stable condition that can support a productive post-mining land use.
Transportation	<p>Construct two overpasses across US Highway 601 (US 601) (to TSF and Champion Pit) to reduce traffic using state roads.</p> <p>Restrict mining-related traffic to roads constructed in the Project area to minimize impacts on local infrastructure.</p> <p>Construct turning lanes for Project entrance to reduce traffic using state roads.</p> <p>Stagger times of starting and ending shifts.</p>
Cultural resources	Implement Memorandum of Agreement and Cultural Resource Monitoring and Mitigation Plan.
Recreation	Return disturbed areas to a stable condition that can support a productive post-mining land use, including recreation.
Air quality	<p>Comply with Air Quality State Construction and Operating permit requirements, conditions, and reporting.</p> <p>Implement dust control measures, including using water sprays to minimize dust at all transfer points.</p> <p>Implement a Fugitive Dust Control Plan.</p> <p>Apply gravel to roadways.</p> <p>Minimize the formation of hydrogen cyanide by maintaining leach solution at a high pH.</p> <p>Use caustic scrubber in the hydrochloric acid (HCl) storage tank to neutralize/eliminate HCl emissions.</p>

**Table 6-2 Summary of Avoidance and Minimization Measures (Continued)**

Resource Area	Avoidance and Minimization Measures
Noise and vibration	<p>Implement vegetative set-back areas from public roadways.</p> <p>Perform blasting with electronic programmable detonators to minimize ground vibrations.</p> <p>Perform blasting only during daylight hours.</p> <p>Use sound-attenuating devices on Mill equipment.</p> <p>Use electric engine starters on mining equipment.</p> <p>Use rubber liners in grinding mills, where appropriate.</p>
Health and safety	<p>Provide around-the-clock security.</p> <p>Restrict access to Project site.</p> <p>Use vegetative screens and fencing to minimize public interaction.</p> <p>Develop detailed pollution prevention plans for process chemical handling and mining operations in accordance with appropriate regulations, permits, best practices, and codes.</p> <p>Comply with the Emergency Planning and Community Right-To-Know Act (EPCRA).</p> <p>Implement Emergency Response Action Plans.</p> <p>Perform toxic release inventory reporting.</p> <p>Implement a Chemical Handling and Storage Plan.</p> <p>Comply with Mine Safety and Health Administration (MSHA) requirements.</p> <p>During reclamation, construct safety berms around any portions of the pit lakes that did not have these during operations.</p> <p>Place appropriate signage during closure to warn of the hazards of the pit highwalls and pit lake.</p> <p>Construct two bridges over US 601 to avoid impact on public safety by mine vehicle movement.</p> <p>Seal abandoned wells.</p>
Hazardous and toxic waste	<p>Implement a Solid and Hazardous Waste Management Plan.</p> <p>Comply with SCDHEC requirements for storage and handling of hazardous and toxic wastes.</p> <p>Construct a building designed to store these materials prior to shipping off site.</p>

Sources: Haile 2013a, 2013b.

### 6.3.2 Additional Mitigation Measures Being Considered by the USACE

The additional measures the USACE is considering to further mitigate potential impacts of the Haile Gold Mine Project are listed in Table 6-3 by resource area. These measures are summarized from Chapter 4 and presented here for convenience.

The USACE will continue to consider these potential mitigation measures during the DA permit application review process. Additional mitigation identified during that process may include minor Project modifications that are considered feasible in terms of cost and constructability.

**Table 6-3 Additional Mitigation Measures Being Considered by the USACE**

Resource Area	Mitigation Measures
Geology and soils	None proposed.
Groundwater hydrology and water quality	Issue a moratorium on potable well installation within the zone of potential groundwater impact (as depicted by the particle tracking results). No new potable supply well may be installed within this area, unless the mine operator can demonstrate that water quality criteria are being and would continue to be met.
Surface water hydrology and water quality	<p>To ensure minimum flows in Haile Gold Mine Creek, Ledbetter Pit Lake could be designed with a permanent minimum release structure.</p> <p>To mitigate impacts of reduced baseflows on streamflows, water temperatures, and water quality, mine releases could be pumped and discharged to other streams in the study area.</p> <p>To mitigate impacts on stream temperatures, holding ponds or constructed wetlands could be used to store water after transport in aboveground pipes and before discharge to surface waters. Additional mitigation measures include shading, covering, or burying the diversion pipes that are currently proposed as aboveground pipes.</p> <p>To mitigate sediment and sediment-associated pollutant loading from the borrow areas and proposed roads, sedimentation ponds could be used to treat runoff prior to discharge to streams.</p> <p>To mitigate water quality impacts associated with the drawdown of Ledbetter Reservoir, monitoring of the water quality and sediment quality could be conducted prior to discharge in order to determine whether treatment is required prior to discharge. Haile and the SCDHEC would develop contingency measures to address adverse water quality detected during monitoring.</p>
Water supply and floodplains	<p>Deepen or replace shallow wells.</p> <p>Replace or modify well pumps.</p> <p>Replace wells, ponds, and springs used for water supplies with an alternative water supply that may include connections to a public water system, storage cisterns, or rooftop water collection/treatment systems.</p> <p>Install clay or synthetic liners in ponds.</p> <p>To mitigate potential impacts to water users, no water supply wells or surface water withdrawals should be permitted within the modeled zone of water quality impacts until monitoring indicates that all water quality standards are met.</p>
Wetlands and Waters of the U.S.	Expand the long-term wetland monitoring locations to address lower Haile Gold Mine Creek, upper and lower Camp Branch Creek, Champion Branch Creek, and the receiving waters of the Little Lynches River.
Terrestrial resources	<p>To minimize long-term impacts on natural communities from reductions in vegetation type and diversity and to improve the time of recovery of reclaimed areas, replant suitable locations with diverse seed mixes and native trees and shrubs.</p> <p>To maximize seed viability in stored growth media, place the most recently removed topsoil onto reclaimed sites.</p> <p>To increase safety for wildlife and create potential riparian habitat, design and implement a sloping littoral shelf at the edges of pit lakes to increase fringing aquatic habitat for wildlife and safe access for wildlife to the water.</p> <p>To address potential wildlife mortality, a wildlife protection and mortality response plan could be developed in consultation with the USFWS and the SCDNR that would be incorporated into permits issued by the USACE and the SCDHEC. This plan should consider such measures as hypersaline TSF solution, decoy wetlands, netting, HDPE floating balls, water hyacinths, reducing the food sources in and around a TSF for foraging, and building alternative freshwater ponds to provide drinking sources away from a TSF.</p>

**Table 6-3 Additional Mitigation Measures Being Considered by the USACE  
(Continued)**

Resource Area	Mitigation Measures
Federally listed species	None proposed.
Socioeconomics and environmental justice	None proposed.
Land use	None proposed.
Transportation	<p>To reduce traffic congestion, develop and implement a construction traffic management plan to address operation and staging of construction vehicles and equipment, and measures to minimize disruption to through-traffic on US 601 during construction of the proposed Haile Gold Mine Entrance driveway and the two proposed overpasses crossing US 601.</p> <p>To reduce traffic congestion, develop, maintain, and implement a transportation phasing and management plan to ensure that necessary transportation improvements are in place to accommodate the Applicant's Proposed Project traffic during both construction and operations.</p> <p>To reduce roadway wear and tear, construct the proposed Haile Gold Mine Entrance driveway in accordance with the conceptual plan in the TIS, modified as necessary through plan development and approval by the SCDOT.</p>
Cultural resources	None proposed.
Visual resources and aesthetics	None proposed.
Recreation	None proposed.
Air quality	None proposed.
Noise and vibration	None proposed.
Health and safety	None proposed.
Hazardous materials and waste	None proposed.

### 6.3.3 Applicant's Proposed Monitoring and Management Plan

The Applicant has submitted in various documents and reports a number of plans and proposed monitoring and environmental management measures. Haile has compiled these into an MMP (Haile 2013a) that Haile would implement throughout the life of the mine. Contents of the proposed MMP are summarized below. The complete proposed MMP is included in Appendix G to enable readers of the EIS to understand the monitoring and management measures to which the Applicant has committed.

The objectives of Haile's proposed MMP are to:

- Identify the environmental media that Haile would monitor during the Project and provide a summary of this monitoring;
- Provide an overview of certain major operations and environmental media at the Project site that Haile anticipates would be regulated by the SCDHEC and identify Haile's commitments for each of them; and
- Provide an overview of the major Project facilities to enhance understanding of how Haile's environmental monitoring and management activities would address associated environmental impacts.

Management for environmental protection includes proper operation and maintenance of proposed mine facilities. Although most of Haile's final operational plans are not yet completed, various reports or manuals that include relevant monitoring or management information have been prepared. Manuals and operational plans prepared during Project planning would be supplemented or replaced by the finalized operational plans (or manuals) after any permits are issued to guide actual operations (Haile 2013a). USACE and SCDHEC permit conditions would require agency approval of these plans.

Haile incorporates by reference the following plans and draft operational manuals that are relevant to environmental management at the Project during mining and post-mining:

- Tailing Storage Facility Operations, Inspection, and Maintenance Manual (AMEC 2012a);
- Tailing Storage Facility Emergency Action Plan (AMEC 2012b);
- Overburden Management Plan (Schafer 2010);
- Reclamation Plan (Haile 2013c);

Current versions and/or drafts of these plans and documents can be accessed at <http://www.hailegoldmineeis.com>.

The Applicant would develop additional plans to comply with other operational standards and regulations. These plans include:

- Spill Prevention, Control and Countermeasures (SPCC) Plan;
- Stormwater Pollution and Prevention Plan (SWPPP);
- Overburden Material Testing Program;
- Operational Water Quality Monitoring and Management Plan;
- Operations plans for each major facility;
- Solid and Hazardous Waste Management Plan; and
- Post-Closure Water Quality Monitoring and Management Plan.

The MMP focuses on Haile's commitments for monitoring as required to comply with all applicable permits and regulations. The MMP will be revised as needed based on future permitting decisions (see additional discussion regarding revisions to the MMP in Section 6.3.4 below). Table 6-4 summarizes the monitoring programs in Haile's proposed MMP.

#### **6.3.4 Monitoring and Adaptive Management**

Monitoring is an important part of any mitigation strategy and is used to assess the effectiveness of mitigation efforts. A monitoring program should clearly describe monitoring objectives, performance standards, monitoring methods, a schedule, and reporting. If performance standards are not being met, mitigation can be adjusted as appropriate. For example, monitoring pH levels in pit lakes post-closure would provide information on adjustments to the amount of lime required to lower the pH under actual conditions (as opposed to an estimate). The Applicant's proposed MMP (Appendix G) would be implemented during mining, reclamation, and post-closure and would be modified as the mine progresses in response to changing conditions and new information. During the post-closure period, some wetlands affected by groundwater lowering would recover their pre-mining hydrologic regime and may return to near-baseline functional condition. Monitoring wetlands would provide data to document levels of recovery, and this information may be useful for other projects in the future.

**Table 6-4 Summary of Haile's Proposed Monitoring Programs**

Monitoring Program	Type of Monitoring	Components	Frequency
Groundwater	Water levels	Monitoring wells to monitor depressurization, drawdown extent, and impact on wells outside the Project boundary	Quarterly, or as specified
	Water quality	Basic water quality parameters: cations and anions, metals, nutrients, and other parameters including cyanide, oil and grease, and fecal coliform <sup>a</sup>	Quarterly or annually depending on location
Surface water	Streamflows	Streamflows	Hourly or quarterly
	Water quality	Basic water quality parameters—cations and anions, metals, nutrients, and other parameters including cyanide, oil and grease, and fecal coliform <sup>a</sup>	Quarterly and annually
	Stormwater	Manage and monitor in compliance with the Stormwater Pollution Prevention Plan during construction and operation	As per permit requirements
Stream channels	Stream channel configuration	Cross sections, profile, sediment	Annually
Wetlands	Vegetation	Species presence, cover, woody stems, hydrophytic species	Annually
	Soil	Soil nutrients and hydric indicators	Annually
	Water	Water quality, depth to water table, hydrologic indicators	Annually
TSF monitoring	Structural integrity	Visual examination and geotechnical instrumentation	Periodically
	Drain systems	Water quality sampling and inspection as described above in the shallow groundwater diversion system, leak collection and recovery system, and underdrain collection system	Periodically
Overburden	Overburden material testing program	Collect samples from gold assay boreholes and test geochemical properties to classify overburden as green, yellow, or red	One in ten boreholes
Johnny's PAG	Surface water and ground-water quality	Monitor water quality as described above	According to Water Quality Monitoring Plan
Mill Site and ore processing	Cyanide management	Send weak acid dissociable cyanide levels above 50 parts per million in the tailings stream through the cyanide destruct process	Continuous
	Spill containment system	Individual containment and monitoring of the Process Event Pond in the event of an emergency release  Conduct incident reporting in accordance with the SCDHEC Mine Operating permit	As needed
Water treatment plant	NPDES permit compliance monitoring	Monitor and report in accordance to the NPDES individual discharge permit	As needed

**Table 6-4 Summary of Haile's Proposed Monitoring Programs (Continued)**

Monitoring Program	Type of Monitoring	Components	Frequency
Contact water and tailing slurry pipelines	Spill and leak monitoring	Install pressure-sensing alarms on the tailings slurry process water pipelines	As needed
Reclamation and closure monitoring	Pit lake water levels	Monitor water levels in reclaimed pit lakes	Quarterly
	Pit lake water quality	Monitor pH and water quality to determine appropriate lime additions	As per water quality sampling plan
	Surface water and groundwater	Monitor water quality as described above but decreasing in frequency over time as determined by the success of reclamation	Dependent on results during 30-year period after mine closure
	Passive treatment cells	Monitor treatment effectiveness	As per water quality sampling plan
	Vegetation	Monitor to prevent woody species from becoming established on the TSF and Johnny's PAG	As needed

NPDES = National Pollutant Discharge Elimination System

SCDHEC = South Carolina Department of Health and Environmental Control

TSF = tailings storage facility

<sup>a</sup> Analytes are described in more detail in the respective monitoring and management plans, and are summarized in the Haile Gold Mine Monitoring and Management Plan (Haile 2013a).

Source: Haile 2013a.

The USACE is considering a requirement that the Applicant add certain adaptive management components to the MMP to include a process for revisions or additions as needed. In this way, the MMP would be a dynamic document that is revised as new information is obtained and measures would be adjusted accordingly. This adaptive management component could improve the efficiency of the MMP and result in greater effectiveness, including potential cost savings.

An adaptive management plan component to the proposed MMP would clearly identify monitoring goals and objectives, many of which are already included in the MMP. Standard permit requirements mandate compliance with such operations and monitoring plans, which would be the case for the proposed Project. Monitoring goals and objectives that would be incorporated into the MMP by the addition of an adaptive management component include:

- Parameters to be monitored;
- Location and timing of monitoring;
- Entity responsible for monitoring;
- Evaluation techniques for the information;
- Actions (contingencies, adaptive management, and corrections to future actions) that would be taken based on the information; and
- Methods by which the public can obtain information on mitigation effectiveness and monitoring results.

## 6.4 Literature Cited

AMEC. See AMEC Earth & Environmental, Inc.

AMEC Earth & Environmental, Inc. 2012a. Haile Gold Mine, Inc. Duckwood Tailing Storage Facility Operation, Maintenance, and Inspection Manual. August 31.

AMEC Earth & Environmental, Inc. 2012b. Emergency Action Plan (EAP), Haile Gold Mine, Inc. Duckwood Tailing Storage Facility, Lancaster County, South Carolina. August.

ARCADIS. See ARCADIS U.S., Inc.

ARCADIS U.S., Inc. 2013. Potential Hazards and Measures to Prevent Adverse Impacts to Birds and Other Wildlife. Submitted to Haile Gold Mine, Inc. on July 23, 2013.

Ecological Resource Consultants, Inc. 2013. Wetland Monitoring Plan.

ERC. See Ecological Resource Consultants, Inc.

Haile. See Haile Gold Mine, Inc.

Haile Gold Mine, Inc. 2011. Joint Federal and State Application for Activities Affecting Waters of the United States for Critical Areas of the State of South Carolina, January 11.

Haile Gold Mine, Inc. 2012. Revised Permit Application and Supplemental Information. August 15.

Haile Gold Mine, Inc. 2013a. Haile Gold Mine Monitoring and Management Plan. November.

Haile Gold Mine, Inc. 2013b. Haile Avoidance and Minimization Efforts. December 19.

Haile Gold Mine, Inc. 2013c. Haile Gold Mine Reclamation Plan, Prepared by Schlumberger Water Services, December 2010 and Updated by AMEC Environmental Infrastructure, November 2013.

Haile Gold Mine, Inc. 2013d. Draft Cultural Resources Management and Mitigation Plan Haile Gold Mine, Lancaster County, South Carolina (USACE Permit No. SAC 1992-24112-4IA). Prepared by R.S. Webb & Associates. December 3.

Schafer. See Schafer Limited, LLC.

Schafer Limited, LLC. 2010. Haile Gold Mine Overburden Management Plan. Submitted to Romarco Minerals, Inc. November.

SCDHEC. See South Carolina Department of Health and Environmental Control.

South Carolina Department of Health and Environmental Control. 2005. BMP Handbook. July. Website: <https://www.scdhec.gov/environment/water/swater/BMPHandbook.htm>. Accessed on July 14, 2013.

USACE and USEPA. See U.S. Army Corps of Engineers and U.S. Environmental Protection Agency.

U.S. Army Corps of Engineers and U.S. Environmental Protection Agency. 2008. Compensatory Mitigation for Losses of Aquatic Resources, Final Rule. April 10.

This page is left blank intentionally.